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Published in:
Stem-, spraak- en taalpathologie

Publication date:
2012

Time Reference Teased Apart from Tense

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Background

One of the issues in neurolinguistics is to what extent language problems that people with aphasia suffer from are specific for their brain damage. Possibly, processes that require more cognitive resources for the healthy brain are vulnerable in aphasia. A way to tap into unimpaired language processing is to employ event-related potentials (ERPs). This study compares behavioral data from aphasic participants and ERP data from healthy participants on time reference of verbs in Dutch.

Agrammatic aphasic patients find it more difficult to produce and comprehend verb forms that refer to the past than verb forms that refer to the present, captured by the Past DIscourse LInking Hypothesis (PADILIH; Bastiaanse et al., 2011). The PADILIH predicts that verb forms referring to the past, such as 'wrote', are impaired in agrammatic aphasia, because they are discourse linked: in order to interpret past time reference, an additional link has to be made to some other event time in the discourse. Verb forms referring to the present, such as 'writes', are relatively spared, because they are locally bound: no additional discourse-link is needed because the event time the verb refers to is in the here-and-now of the moment of speaking.

Time reference processing has also been studied in non-brain-damaged individuals. Dragoy et al. (2012) performed an ERP study in Dutch. One of their results is that a violation of a past time reference context by a verb with non-past time reference in present tense such as *De kelner die zonet de peper *maalt,...* ('The waiter who a-minute-ago *grinds the pepper,...) evokes a P600 effect, typical for morphosyntactic difficulties (Osterhout & Holcomb, 1992).

Predictions

The reported differences in present and past time reference processing have mainly been investigated in synthetic verbs (which are single verb forms such as 'writes'), in which the values for tense and time reference overlap. This makes it difficult to distinguish between the roles of tense and time reference processing. Interestingly in Dutch, reference to the past can be done by a synthetic verb in the past tense; the past imperfect (such as 'wrote'), but also

by *present tense* in the periphrastic present perfect (such as 'has written'). The latter form consists of an auxiliary in present tense plus a participle. This provides an excellent opportunity to determine whether it is tense or time reference that underlies the difficulties agrammatic speakers encounter with time reference of verbs. If it were past time reference through tense only, the present perfect and the present imperfect should both be relatively spared as compared to the past imperfect. Based on the PADILIH, it is predicted that reference to the past will also be impaired if it is done through the present tense.

In parallel, it is hypothesized that healthy participants treat reference to the past through past and present tense similarly. It is, thus, predicted that that in the healthy brain the ERP effects to time reference violations are caused by the *time frame* to which the verb morphology refers - and not by the tense value per se. If that is true, the P600 effect will occur if a time reference violation is made, also one that cannot be ascribed to tense. This can be done by comparing conditions in which past and non-past time reference are both expressed through present tense.

Method and results

Aphasia study

In the aphasia study, 11 Dutch agrammatic patients were tested in a sentence-completion paradigm on production of Past Imperfect, Present Perfect, and Present Imperfect, with 18 items per condition. In a mixed-effects regression analysis their average accuracy scores in the conditions with past reference past (15% on Past Imperfect correct and 28% on Present Perfect correct) were not significantly different ($z = 1.62$, $p > .1$). The average accuracy on Present Imperfect (46%) was significantly higher than on Past Imperfect ($z = -4.70$, $p < .001$) and on Present Perfect ($z = -3.21$, $p < .01$).

ERP study

In the ERP study, 32 healthy participants read sentences with auxiliaries followed by a participle or infinitive. The auxiliaries in the contrasts had the same (present) tense, but time reference values were manipulated. This means that any appearing effect cannot be attributed to tense, but has to be due to time reference. Verbs referring to the past, such as in: *De opa die zonet de peper heeft gemalen, . . .* ('The grandpa who a-minute-ago [has-ground] the pepper. . . ') were contrasted with verbs referring to the non-past, such as in: *De opa die zonet de peper *gaat malen, . . .* ('The grandpa who a-minute-ago *will grind the pepper. . . '). These time reference violations evoked a P600 effect on the auxiliary.

Discussion

These studies teased tense and time reference apart and showed that the problems with time reference of verbs in agrammatic aphasia are not related to tense. Past time reference is impaired compared to present time reference, even when conveyed through a verb construction in present tense. The underlying problem is a deficit in referring to the past, as predicted by the PADILIH.
Healthy participants interpreted the past time reference of the Present Perfect already at the point of the auxiliary. When the present tense auxiliary cannot be used to refer to the past, a time reference violation occurs, reflected in the P600 effect. This outcome is similar to the one of Dragoy et al. (2012) for synthetic verbs and has been interpreted as a reaction to time reference violation by the verbs and not to a tense violation. It confirms that the healthy brain treats verb forms in past or in present tense in a similar way when they are used to refer to the past. Parallel to people with aphasia, non-brain-damaged people process verbs referring to the past differently from verbs that do not refer to the past.

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